

REMARKS

The rejections under:

35 U.S.C. § 103(a) of Claims 1-2, 5-8, 11-12 and 15-16 as unpatentable over JP 2000-090972 (Kuruma et al) in view of U.S. 6,399,251 (Honbo et al), and of Claims 3-4, 9-10 and 13-14 over Kuruma et al in view of Honbo et al, and further in view of U.S. 6,103,373 (Nishimura et al); and

under the judicially created doctrine of obviousness-type double patenting of Claims 11-12:

over Claims 1, 3, 7 and 15 of U.S. 6,294,292 (Tsushima et al) in view of Honbo et al, and

over Claims 1, 3, 5 and 7-8 of U.S. 6,558,846 (Tsushima et al) in view of Honbo et al, are respectfully traversed.

The present invention, in its broadest disclosed embodiment, is drawn to a secondary power source, which comprises a positive electrode containing activated carbon, a negative electrode containing a carbon material capable of doping and undoping lithium ions, and an organic electrolyte containing a lithium salt, wherein the negative electrode has a density of from 0.6 to 1.2 g/cm<sup>3</sup>.

As described in the specification at page 1, first full paragraph, the inventive secondary power source has a high upper limit voltage, a large capacity and a high reliability for large current charge and discharge cycles.

As described in the specification beginning at page 1, line 6, the prior art has distinguished various secondary power source materials, such as electric double layer capacitors and lithium ion secondary cells based on the particular materials used for the positive electrode and the negative electrode. The materials affect properties such as upper

limit voltage, capacity and durability against quick charge and discharge cycles. Applicants have discovered a particular problem with regard to a particular secondary power source, i.e., one that comprises a positive electrode containing activated carbon, a negative electrode containing a carbon material capable of doping and undoping lithium ions, and an organic electrolyte containing a lithium salt. In effect, Applicants discovered that the density of the negative electrode is a result-effective variable that affects both the initial capacity and the change in capacity.

In other words, Applicants have discovered a correlation between the density of the negative electrode and cycle performance of quick charge and discharge. Namely, they have found that the lower the density of the negative electrode, the lower the rate of decrease in capacity due to quick charge and discharge, and when the density becomes lower than a predetermined value, the rate of decrease in capacity becomes substantially constant, as described in the specification bridging pages 6 and 7.

Applicants describe, beginning in the specification at page 4, line 25, that a secondary cell as well as an electric double layer capacitor is a kind of a secondary power source but, in the present specification, a secondary power source of a specific construction wherein the positive electrode contains activated carbon and the negative electrode contains a carbon material capable of doping and undoping lithium ions, will be referred to simply as a secondary power source.

In the specification, beginning at page 5, line 6, Applicants distinguish the secondary power source of the present invention compared to a lithium ion secondary cell:

In a lithium ion secondary cell, the positive electrode is an electrode composed mainly of a lithium-containing transition metal oxide, and the negative electrode is an electrode composed mainly of a carbon material capable of doping and undoping lithium ions. Lithium ions are undoped from the lithium-containing transition metal oxide in the positive electrode by charging and doped in the carbon material capable of doping

and undoping lithium ions in the negative electrode, and lithium ions are undoped from the negative electrode by discharging and doped in the positive electrode. Accordingly, lithium ions in an electrolyte are not substantially involved in charge and discharge of the cell.

On the other hand, in the secondary power source of the present invention, anions in the electrolyte are adsorbed on the activated carbon in the positive electrode by charging, and lithium ions in the electrolyte are doped in the carbon material capable of doping and undoping lithium ions in the negative electrode. Further, by discharging, lithium ions are undoped from the negative electrode and anions are desorbed from the positive electrode. Namely, in the secondary power source of the present invention, the solute in the electrolyte is substantially involved in the charge and discharge, and the mechanism of the charge and discharge is different from that of the lithium ion secondary cell. Further, doping and undoping of lithium ions are not involved in the positive electrode of the secondary power source of the invention, which is different from the lithium ion secondary cell, and the positive electrode does not deteriorate due to doping and undoping of lithium ions, and accordingly the secondary power source of the present invention is less likely to deteriorate by charge and discharge cycles as compared with the lithium ion secondary cell, and is excellent in a long-term reliability.

Kuruma et al, and the claims of both Tsushima et al patents, disclose nothing more than what Applicants have already described in the specification as known. The Examiner concedes that none of this prior art discloses or suggests the presently-recited negative electrode density.

The Examiner relies on Honbo et al as describing a lithium secondary battery with a negative electrode of a carbon material having a density in the range of 0.95-1.5 g/cm<sup>3</sup>. However, the positive electrode material of Honbo et al is a "complex oxide containing Li and Mn, which has a spinel type crystalline structure" (column 2, lines 38-40). Honbo et al discloses that the density range of 0.95-1.5 g/cm<sup>3</sup> of the negative electrode material prevents the precipitation of Mn (dissolved from the positive electrode material) on and inside the negative electrode (column 4, lines 5-17). Thus, Honbo et al discloses that the density range of the negative electrode material of Honbo et al should be selected to minimize a failure

mode which is specific to the Li/Mn oxide composition of the positive electrode material of Honbo et al.

However, the claimed secondary power source has a completely different kind of positive electrode material (i.e. activated carbon) which cannot fail in the manner described in Honbo et al (activated carbon does not contain the Mn ions which Honbo et al discloses can precipitate in the negative electrode material). Consequently, the specific failure mode described in Honbo et al is not possible in the claimed secondary power source. Thus, one of ordinary skill in the art of preparing secondary power sources would not reasonably consider the disclosure of Honbo et al to apply to the claimed secondary power source, in which the positive electrode material consists essentially of or comprises activated carbon.

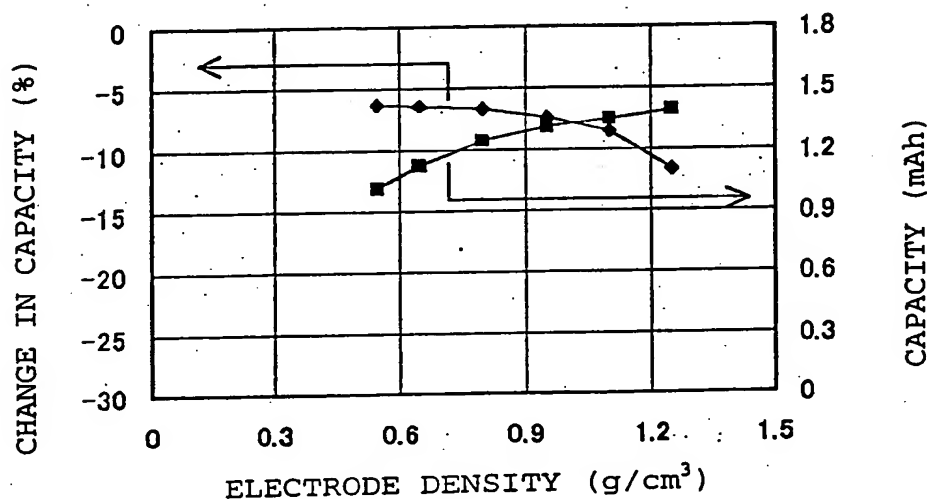
Accordingly, Honbo et al does not reasonably suggest combining an activated carbon positive electrode with a carbon material negative electrode having a density in the claimed range.

As described above, none of the other applied references describe the density of the negative electrode material, and therefore fail to recognize that the negative electrode density is result-effective in a secondary power source having an activated carbon positive electrode material and a carbon material negative electrode material. Accordingly, the combination of Honbo et al and the remaining applied references also fails to suggest the claimed secondary power source.

Furthermore, Table 1 at page 17 of the present specification demonstrates the criticality of the claimed density range of the negative electrode. Example 6 is a secondary power source which is otherwise identical to that of Example 1, except that the negative electrode density is  $0.55 \text{ g/cm}^3$ , and Example 7 is a secondary power source otherwise identical to that of Example 1, except that the density of the negative electrode is  $1.25 \text{ g/cm}^3$ . In other word, the secondary power source of Example 6 has a negative electrode density

somewhat lower than that of the claimed range, and the secondary power source of Example 7 has a negative electrode density somewhat higher than that of the claimed range. The secondary power source of Example 6 has a significantly lower initial capacity than that of Example 1, and the secondary power source of Example 7 has a significantly greater reduction in capacity after 2000 cycles, compared to Example 1. Thus, the claimed secondary power source has superior performance characteristics compared to otherwise identical secondary power sources having a negative electrode density outside the claimed range. Accordingly, none of the applied references, either individually or in combination, suggest the claimed secondary power source.

The above-discussed data is graphically shown in Fig. 1 of the specification, reproduced below:



In response to the above arguments, the Examiner finds that "the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985)."

In reply, *Obiaya* is inapposite, because the prior art does **not** suggest the present invention. Honbo et al is an example of a lithium ion secondary cell, discussed above and described in the specification herein at page 5, lines 6-19, which operates according to a different mechanism from that of the secondary power source of, for example, Kuruma et al, the claims of the Tsushima et al patents, and the present invention. Indeed, the lithium secondary battery of Honbo et al is irrelevant with regard to secondary power sources of the specific construction herein, and of Kuruma et al and the claims of the Tsushima et al patents. Nor do Applicants agree that Honbo et al is even within the inventor's field of endeavor, which field does not include lithium ion secondary cells in which the positive electrode is composed mainly of a lithium-containing transition metal oxide.

Regarding the Examiner's criticism of the comparative data of record, Applicants respectfully submit that there is no *prima facie* case of obviousness, so that any criticisms are moot. Nevertheless, even if there was such a *prima facie* case, it is respectfully submitted that the Examiner is being overly strict. The Examiner has offered no reasons why one skilled in the art would have expected different conclusions using, for example, as constants, different binder materials, conducting agent materials, current collector materials, electrolytes, and the like. Indeed, in each of Examples 1 to 4, 6 and 7, the only variable was the negative electrode density. The Examiner has not explained why one skilled in the art would not accept the evidence of record as demonstrating the significance of the negative electrode density.

As further evidence that Honbo et al does not present a *prima facie* case of obviousness, the comparative data of Honbo et al demonstrates that for purposes of Honbo et al's invention, a negative electrode density within a particular range, while necessary, is not sufficient. Honbo et al require that a number of variables therein be satisfied, such as half

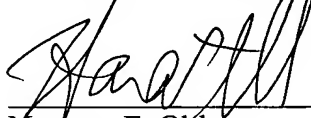
value of the peak (400), average primary particle diameter, specific surface area of secondary particles, lattice constant of active material, in addition to negative electrode density. Indeed, Honbo et al's Comparative Examples 1, 3 and 4 show that even when the density is within Honbo et al's range, their battery is deficient because all the other variables are not satisfied. Interestingly, the battery of Honbo et al's Comparative Example 2 is deficient when the density is  $0.91 \text{ g/cm}^3$ , which density is outside Honbo et al's range but well within Applicants' range.

For all the above reasons, it is respectfully requested that the above rejections be withdrawn.

All of the present claims are believed to be in immediate condition for allowance. Accordingly, it is respectfully requested that the Examiner pass this application to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Norman F. Oblon  
Attorney of Record  
Registration No. 24,618

Customer Number  
**22850**

Tel: (703) 413-3000  
Fax: (703) 413 -2220  
(OSMMN 08/03)  
NFO/HAP/cja

Harris A. Pitlick  
Registration No. 38,779